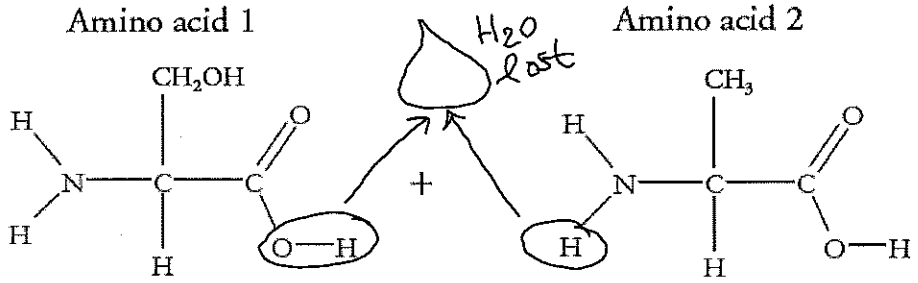
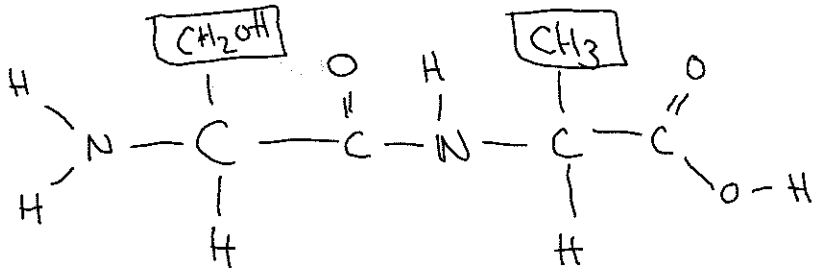
**Concept 1: Biochemistry**

***Thinking Practice Questions***

1. If the following molecules were to undergo a dehydration synthesis reaction, what molecules would result? **Circle** the parts of each amino acid that will interact and **draw** the resulting molecule.



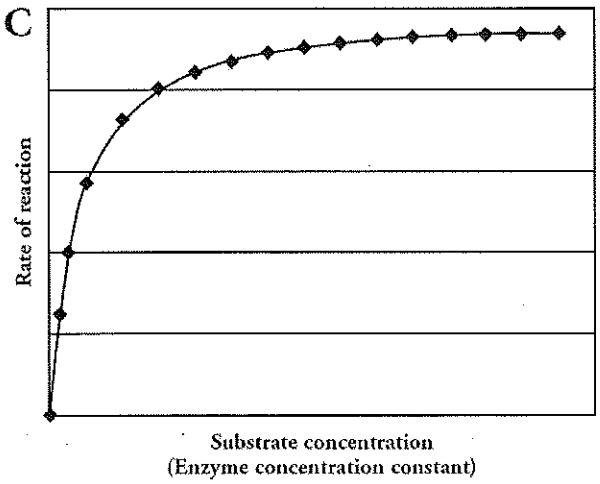

2 amino acids are joined through dehydration synthesis to form a dipeptide.




2. Identify which of the six main elements (CHNOPS) are found in each of the four macromolecules (carbohydrates, lipids, proteins, and nucleic acids).

Carbohydrates = C,H,O (always in a 1:2:1 ratio)
Lipids = C,H,O (mostly C and H)
Proteins = C,H,O,N, and sometimes S (in R groups)
Nucleic Acids = C,H,O,N,P

3. Describe the relationship between substrate concentration and reaction rate shown in the graph below and propose an explanation for it.




As substrate concentration increases, the rate of reaction increases because there are more substrate molecules for the enzyme to act upon. However, once all enzymes are "saturated" with substrate molecules, the rate of reaction cannot increase further.

4. DNA polymerase from *T. aquaticus (Taq)* is used in PCR (polymerase chain reaction). PCR is a technique where millions of copies of DNA can be made from one original copy. In this method, the target DNA molecule is subjected to temperatures over 95 °C to make the double-stranded DNA separate. The temperature is then lowered slightly to allow primers to anneal before the *Taq* polymerase catalyzes the reactions to incorporate new nucleotides into the complementary strands. The cycle is then repeated over and over until there are millions of copies of the target DNA.

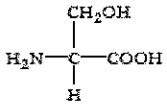
   a. Predict why this bacterial polymerase is used instead of a human polymerase.

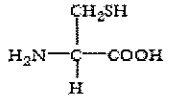
It can withstand high temperatures without denaturing.

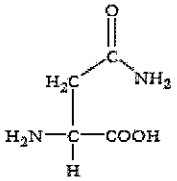
   b. What would happen if you used a human polymerase in a series of PCR reactions?

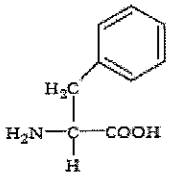
The DNA strands will still separate and the primers will anneal, but the polymerase will be unable to copy the sequences because it has denatured.

22. Imagine a protein chain that includes the following amino acids among several others.


Serine


Cysteine


Asparagine


Phenylalanine

*a.* Which of the amino acids could form a hydrogen bond with another amino acid in the chain to stabilize the secondary structure of a β-pleated sheet?

*b.* Which of the amino acids could form disulfide bonds with another amino acid in the chain to stabilize the tertiary structure of the protein?

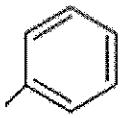
*c.* Which of the amino acids could participate in hydrophobic interactions with another amino acid in the chain to stabilize the tertiary structure of the protein?

a. In a hydrogen bond, an "H" on one molecule is attracted to an N, O, or F on another molecule. In protein secondary structure, hydrogen bonding occurs between non-adjacent amino (NH2) and carboxyl (COOH) groups. Because all the amino acids shown have an amino group and a carboxyl group (as do all amino acids), hydrogen bonding can occur between any of them.

b. Disulfide bonds occur between two amino acids that have R groups with the element sulfur. Two cysteine amino acids can form disulfide bonds with one another.

c. Hydrophobic interactions occur between nonpolar R groups in the tertiary structure of a protein. Cysteine and phenylalanine both have nonpolar R groups so hydrophobic interactions can form between these amino acids.

Note: The following structure is called a benzene ring, which only contains carbon and hydrogen atoms and is therefore nonpolar.



***Short Response Question***

Water is important for all living organisms. The functions of water are directly related to its physical properties. Describe how the properties of water contribute to TWO of the following:

- Transpiration
- thermoregulation in endotherms
- plasma membrane structure

**(a) 4 point maximum**

2 points for each process / one point per category in the context of linking property to contribution

| Process | Property | Contribution to Process |
|---|---|---|
| Transpiration | polarity/cohesiveness | water movement |
| | high heat of vaporization | reduces water loss |
| | water potential | water movement |
| Thermoregulation | high heat of vaporization | evaporative cooling |
| | high specific heat | heat buffer |
| Plasma membrane | polarity | arrangement of phospholipids |